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To: Mr. G.W. Jackson
Manager
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H13B27

INTERFERENCE STUDY - EAR FALLS GS

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Tests were conducted in order to locate the EMI sources affecting the Ear Falls GS to Manitou Falls GS radio link communication system. One major interference source and several minor sources were located. Test results are summarized.

INTRODUCTION

A severe interference problem is being experienced on the radio communication link between Ear Falls GS and Manitou Falls GS. Electrical Research received a request from Mr. T.W. Miller of Design and Development Division, Telecommunication Department to provide our expertise to solve the problem. Electromagnetic interference (EMI) measurements were performed at Ear Falls GS and Manitou Falls GS on October 2, 1985 through October 4, 1985.

This report summarizes the test results and provides recommendations for remedial action.

INSTRUMENTATION

EMI Mobile Test Facility (truck mounted equipment) for calibrated noise measurements

1. Ailtech NM37/57A EMI-Field Intensity Meter for calibrated noise measurements.

2. Oscilloscope connected to linear video output of NM37/57A for observation of noise pulses.

3. HP X-Y Recorder for recording noise spectra (30-200 MHz).

4. Philips chart recorder for monitoring the noise levels at the Y output of the NM37/57A.

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5. TVI Analyzer (designed by Research Division) for measuring Average Crossing Rate (ACR) and Amplitude Probability Distribution (APD) characteristics of the noise.

6. HP 9826 computer and thinkjet printer for programmed printouts and graphs of noise measurements.

7. Biconical antenna (30-200 MHz) and extendible (up to 10 m) truck mounted mast.

Portable (hand held instruments) for Locating EMI Sources

1. HP Model 4914 Ultrasonic Detector and parabolic reflector.

2. Micro Tech Model 1000 Power Line RFI Gun. (470-890 MHz).

3. Little Snoop (Broad Band Detector).

TEST DESCRIPTION:

The Radio Transmitters operate at 150 MHz at Ear Falls GS and 169 MHz at Manitou Falls GS. Interference at these relatively high frequencies suggests a severe noise source. Listening to the radio system at Ear Falls, one could identify a definite problem. The transmitters were operating at 80 watts output, much higher than the desired 40 watts, in order to overcome the interference. This did not work.

Ear Falls Area

October 2, 1985: Sunny, with light wind.

A survey was performed inside Ear Falls TS. The noise levels were approximately 45 dB above 1 uV/MHz at 70 MHz. Outside the front gate with the biconical antenna pointing towards the steel tower transmission lines E4D and M3E, the noise levels increased to 70 dB. At a measurement frequency of 130 MHz the measured value was approximately 50-55 dB. When the antenna was turned away from E4D and M3E and towards 115 kV E1C line or 44 kV 1M1 line the levels were approximately 45-50 dB at 70 MHz. At the river crossing of E4D and M3E (which was farther along the line) the levels dropped to approximately 45-50 dB. The highest noise levels were from the turning tower by the front gate of Ear Falls GS. The 115 kV woodpole lines were also surveyed but noise levels were not as high.

The portable instruments (ultrasonic detector and RFI gun) both confirmed that a large noise source was present on the first turning tower out of Ear Falls GS. The ultrasonic detector pinpointed the bottom insulator on a loop support string on E4D as the source. Oscilloscope pictures also confirmed that a large gap type noise source was apparent.

October 3, 1985: Steady rain most of the day.

Most of the noise sources were eliminated. Several locations were surveyed with levels ranging from 25 dB to 45 dB. There was still interference but at a much lower level, on the Ear Falls Radio Receiver. Some noise sources were found around the Ear Falls TS that are most likely the problem. The station radio operators said that they would not be concerned with the interference levels experienced during rain.

October 4, 1985: Heavy fog in the morning.

The interference sources were still very low level. The main gap type noise source was not present. By mid day the line started to dry up. The fog lifted, and the noise sources started to slowly return. Beside the Ear Falls TS front gate, with the antenna pointed towards the E4D turning tower, the noise levels started to increase. At 70 MHz the level was 50-53 dB. At 130 MHz the level was 35-40 dB. By the river crossing of E4D with the antenna pointed in the direction of Ear Falls GS the measured value at 70 MHz was 45 dB, and at 130 MHz, it was 28-32 dB.

Noise levels never reached as high as on October 2 because of another rain shower later in the day.

Manitou Falls Area

Although most of the EMI surveys were concentrated around Ear Falls GS, the Manitou GS site was surveyed on two occasions. On October 3 and October 4, a brief EMI survey was conducted at the headwater dam site and the Manitou Falls GS parking lot. At these times, minor noise sources were detected at maximum levels of 30 dB. The radio receivers were clear of any interference. No further investigations were conducted at this location.

On October 4, a source was temporarily found where the E4D 115 kV wood pole line crosses highway No 804. A brief shower eliminated the source. However, the biconical antenna direction was towards Ear Falls GS. This could have been indicating the same source found earlier.

SUMMARY OF RESULTS AND RECOMMENDATIONS

The results suggest that the main EMI source is the first turning tower outside the gate of Ear Falls GS. It is very close to the radio receiving tower and within the antenna line-of-sight. However, due to the wet weather conditions during the investigation, there is, nevertheless, some uncertainty. There were also other gap sources at lower levels that were apparent on the scope pictures but were not as severe.

For the identification of EMI sources located, several corresponding oscilloscope photographs have been attached (See Figures 1, 2, and 3).

The noise sources are listed below:

Major Source:

1. Line E4D 115 kV, first turning tower out of gate. Bottom loop support vertical insulator string.

   ACTION: - insert anti-interference cotter pins in insulator strings. All three towers at Ear Falls side of river should be considered.

   - tighten conductor clamp.

   - replace if insulator string and clamp are badly corroded.

Minor Sources: (Inside Ear Falls TS)

1. Transformer T5 secondary 44 kV, third pole out from T5, side mounted, grey insulator facing road.

   ACTION: - replace insulator with post type insulator.

2. Line 1M1, Red Phase, DS side, 44 kV breaker bushing.

   ACTION: - inspect and replace bushing if defective.

3. Line E2R, main structure, station side of line disconnect, loop support insulator string and clamps. (Middle phase the worst, but all phases noisy).

   ACTION: - remove lead weight and binding wire.

   - insert anti-interference cotter pins in insulator strings.

   - tighten conductor clamps or replace if badly corroded.

4. Transformer T4, wood poles 44 kV, bad insulators - Loose pins and cross arm braces.

   ACTION: - replace insulators with post type insulators.

   - tighten all loose hardware.

DISCUSSION

If the suggested work is carried out on the interference sources it should temporarily eliminate the problem. This will extend the life of the existing radio communication system for an indefinite period of time.

With 115 kV wood pole lines, several steel transmission turning towers and the DS and TS in the area, future noise sources are likely and the interference may resume.

Approved:

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Submitted:

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Communication Group
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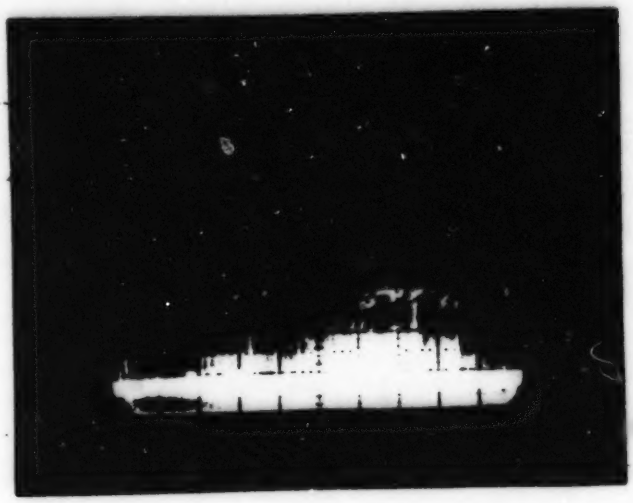
DRG:td

OUTSIDE FRONT GATE EAR FALLS GS
ANTENNA DIRECTION TOWARDS M3E, E4D

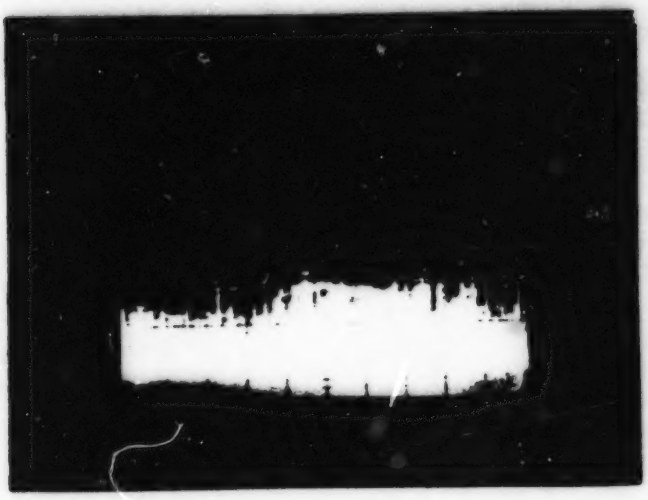
October 2, 1985 - Sunny, Light wind



5 V/div, 2 ms
37/57 → 65 dB, 70 MHz

DAM SITE PARKING LOT
INSIDE EAR FALLS TS

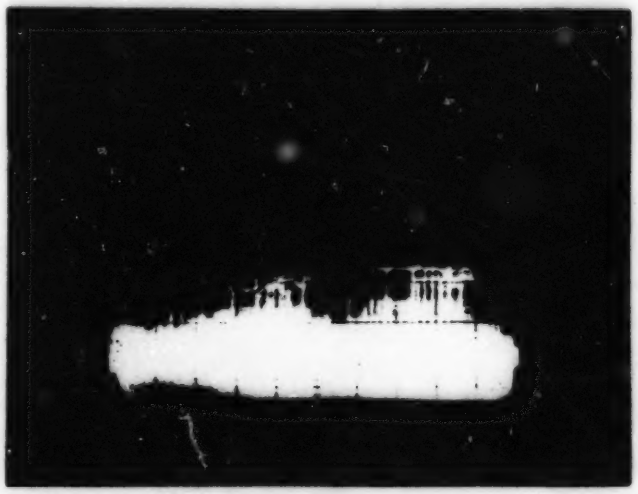
October 2, 1985



5 V/div, 2 ms
37/57 → 45 dB 70 MHz

OUTSIDE FRONT GATE EAR FALLS GS
ANTENNA DIRECTION M3E, E4D

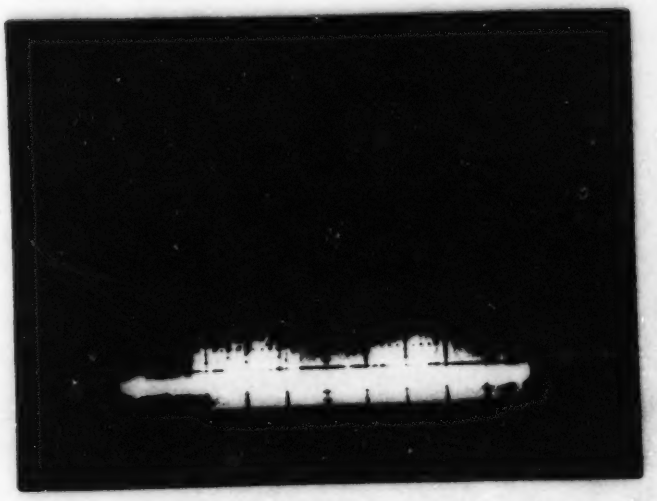
October 2, 1985



5 V/div, 2 ms
37/57 → 70 dB, 70 MHz

OUTSIDE FRONT GATE EAR FALLS GS
ANTENNA DIRECTION M3E, E4D

October 2, 1985



5 V/div, 2 ms, 130 MHz
37/57 → 55 dB

FIGURE 1

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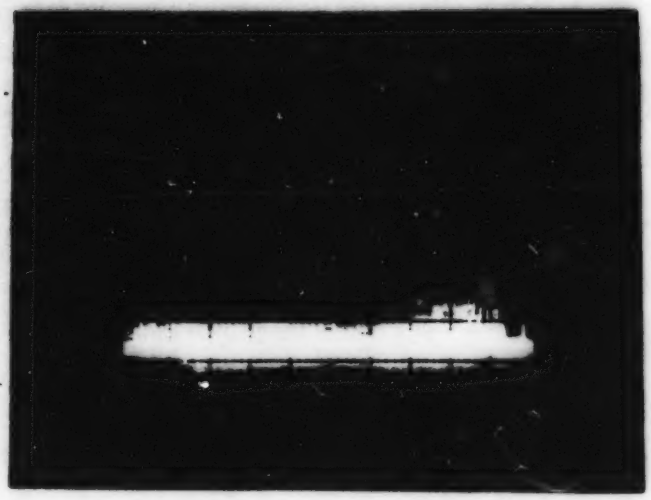
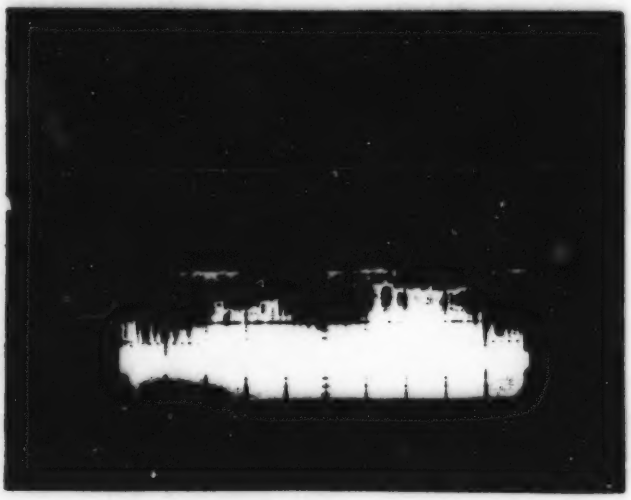
GREEN HOUSE BY RIVER CROSSING OF M3E, E4D
ANTENNA DIRECTION TOWARDS EAR FALLS GS

October 2, 1985



5 V/div, 2 ms
37/57 → 70 dB, 70 MHz

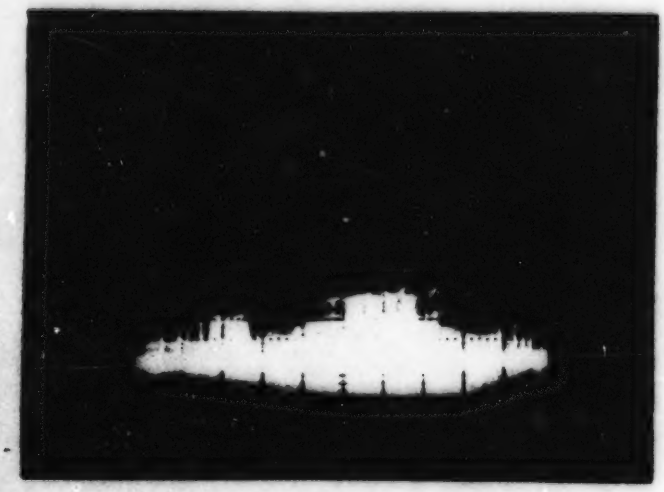
October 2, 1985



5 V/div, 2 ms
37/57 → 55 dB, 70 MHz

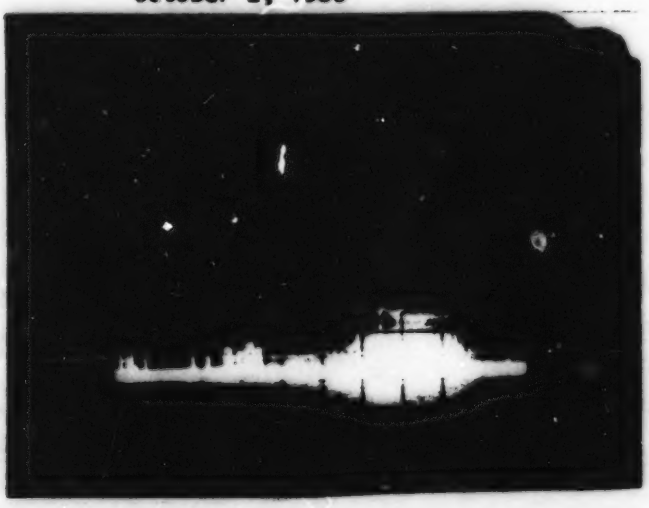
LITTLE CANADA CAMP BY RIVER CROSSING OF M3E, E4D
ANTENNA DIRECTION TOWARDS MANITOU SIDE OF RIVER

October 2, 1985



5 V/div, 2 ms
37/57 → 50 dB, 70 MHz

October 2, 1985



5 V/div, 2 ms
37/57 → 40 dB, 128 MHz

FIGURE 2

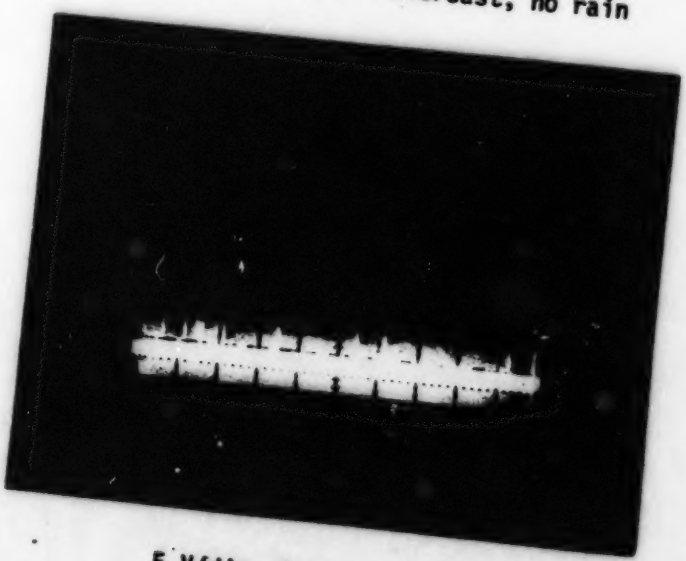
BRIDGE ON TOP OF DAM - EAR FALLS GS
BESIDE RADIO TOWER AND ANTENNA

October 3, 1985 - Steady rain

5 V/div, 2 ms
37/57 → 25-30 dB, 70 MHz

MANITOU FALLS HEAD WATER DAM SITE

October 4, 1985 - Overcast, no rain



5 V/div, 2 ms
37/57 → 30 dB, 70 MHz

FIGURE 3